PATENT SPECIFICATION (11) 1354057

1354057

(21) Application No. 33864/72 (22) Filed 19 July 1972

(44) Complete Specification published 22 May 1974

(51) International Classification E04H 17/02

(52) Index at acceptance
E1B 34C 34X
G4N 1C4 2E 2V 2W 4B 5A3 6B2

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(54) IMPROVEMENTS IN SECURITY FENCES

(71) We, PYE DYNAMICS LIMITED, a British Company of Park Avenue, Bushey, Hertfordshire, and THE SECRETARY OF STATE FOR THE HOME DEPARTMENT, Home Office, Whitehall, London SW1 2AP, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a security fence for a perimeter or boundary which is required to be guarded against escape and/or intrusion. The fence is particularly intended to be mounted on top of a wall or parapet.

The invention consists in a security fence comprising a plurality of spaced posts and wires extending between the posts wherein said fence incorporates strain gauges which are arranged to produce a warning signal if a stress above a predetermined threshold limit is imposed on any of the wires or posts.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a perspective view of a portion of one embodiment of fence according to the invention,

Figure 2 is a view of a fence post looking at right-angles to the line of the fence,

Figure 3 is a view of a fence post looking along the fence,

Figures 4*a* and 4*b* respectively show a plan view and an elevation of wire anchoring and wire tensioning devices employed in the fence,

Figures 5*a* and 5*b* respectively show an elevation and a plan view of a first form of double cantilever support unit,

Figures 6*a* and 6*b* respectively show an elevation and a plan view of a second form of double cantilever support unit,

Figure 7 is a part-sectioned diagrammatic drawing of a fence post and cantilever assembly showing the arrangement of the strain gauges, and

Figure 8 is a schematic diagram of a strain gauge bridge circuit.

Referring to Figures 1, 2 and 3, a section of a perimeter wall is indicated by the reference 1 and a concrete coping is indicated by the reference 2. In Figure 1 a portion of the coping is shown cut-away to reveal an anchor unit 3, which is secured to the wall, e.g. by rag bolts, in a cavity cast in the coping 2 and shown by the broken outline 4. The anchor unit 3 carries brackets 5 and 6 which extend upwards to a height just below the top of the coping 2 and are spaced apart by a distance such that a post comprising a length of square section tube enters freely between them. The post 7 is carried by a pivot pin 8 which passes through a hole in the post and corresponding holes in the brackets 5 and 6, so that it can rotate about the pivot pin in a direction normal to the line of the wall 1. The post 7 is retained in a vertical position by shear pins 9 which pass through holes in the brackets 5 and 6 and enter corresponding holes in the post 7. Typically the shear pins 9 comprise short lengths of 1/16th inch diameter gilding wire. The post 7 passes through a flexible gaiter 10 which is secured to the coping 2 so as to seal the cavity 4 against the weather and against the ingress of foreign bodies which might obstruct the movement of the post.

Each post 7 is mounted in a similar manner and is also provided with stays 11 of T-section which are secured at their upper ends to lugs 12 attached on opposite faces of the post towards its upper end. The lower ends of the stays 11 are connected to the post by substantially horizontal struts 13, secured at their one ends to lugs 14 mounted on opposite faces of the post 7 and at their other ends to the webs of the T-section stays, such that the lower ends of the stays 11 approach the upper face of the coping 2 at points equidistant from either side of the post 7. A cam 15 in the form of a circular disc with an eccentric bush is attached to the lower end of each of the stays 11, in such a manner that the effective length of each stay can be varied by rotating the cam. Each cam 15 rests on a bearing plate 16 secured to the coping 2. By suitably rotating the cams 15, the dimensional tolerances are taken up and the cams are then locked, e.g. by a locknut, to the respective stays. In this manner the post 7 is rendered rigid in a direction parallel

to the axis of the wall, while it remains free to rotate about the pivot pin 8 except for the restrain of the shear pins 9.

A hole 17 is provided through the post 7 near its upper end, at right angles to the line of the fence, and a similar hole 18 is provided through the post above the top of the gaiter 10. As shown in Figure 3, a double cantilever support unit 19 is passed through the hole 17 and is secured so that it projects symmetrically from either side of the post by means of a taper pin 20 passing through a hole in the centre of the cantilever unit and corresponding holes in the side walls of the post 7. A second cantilever unit 21 is similarly secured in the hole 18.

A wire support unit 22 of T-section is secured by its web to the projecting ends of the cantilever units 19 and 21 on one side of the post 7, and a wire support unit 23 is secured to the opposite ends of the cantilever units on the other side of the post. In the interests of clarity, the cantilever units 19 and 21 and the wire supports units 22 and 23 are omitted from Figure 2, and the stays 11, lugs 12 and 14 and struts 13 are omitted from Figure 3.

Referring to Figure 1, it will be seen that for each successive pair of posts two wires are strung between the support units 22 on one side of the posts and three wires are strung between the support units 24 on the other side of the posts.

Each wire is attached to the support unit at one end of its span by an anchorage device incorporating a shear pin, and to the support unit at the other end of its span by an adjustable tensioning device. Typical anchorage and tensioning devices are shown in Figures 4*a* and 4*b*.

The anchorage device comprises plates 24 and 25, secured one either side of the flange of a wire support unit 22 or 23 by a bolt and nut 26. An end of the wire is secured round a thimble 27 which fits between the plates and is retained by a shear pin 28 passing through corresponding holes in the plates and through a hole at the centre of the thimble. The tensioning device comprises a threaded rod 29, having a hole adjacent one end through which the wire is secured to the rod. The rod passes through a clearance hole in the web of the wire support unit 22 or 23 and is retained by washers and locknuts 30 on each side of the web. By adjusting the nuts 30 any required tension can be applied to the wire up to the limit imposed by the strength of the shear pin 28. The tensions in the two sets of wires attached to any one wire support unit are initially adjusted to be substantially equal, so that there is little or no resultant force tending to deflect the cantilever units 19 and 21 which carry that support unit. If the wires are tampered with, the tension in one or more will be altered, destroying the balance of forces and producing a deflection which is detected by strain gauges affixed to the cantilever units, as will hereinafter be described.

The double cantilever unit 19 is shown in more detail in Figures 5*a* and 5*b*. It is formed from a length of e.g. stainless steel rod. The central portion 31, of a length equal to the thickness of the post 7 is of circular section of a diameter to fit snugly in the hole 17. At the mid-point of the central portion a hole 32 is provided to accommodate the taper pin 20.

At either end of the unit 19 flat surfaces 33 are formed to provide a bearing for the webs of the wire support units 22 and 23. Holes 34 enable the wire support units to be bolted in the ends of the cantilever unit 19.

Between the flats 33 and the central portion 31, further flat webs 35 are formed, such that the cross-section of these portions of the unit 19 is rectangular with the minor dimension small compared with the major dimension. When the unit 19 is mounted in the post 7 the major dimension is vertical. Consequently the cantilever carrying the wire support unit on either side of the post 7 is stiff in the vertical direction and relatively flexible in the horizontal direction.

A strain gauge 36 is bonded to a flat web 35 on one side of the centre of the unit 19 and a similar gauge 37 is bonded to the corresponding surface on the other side of the centre.

The double cantilever unit 21 illustrated in Figures 6*a* and 6*b* is generally similar to the unit 19, but is of constant circular section between the end flats 33. Strain gauges 38 and 39 are symmetrically disposed on either side of the centre of unit 21, so as to be influenced by deflection of the unit in a horizontal direction. The unit 21 is very much more stiff in horizontal deflection than is the unit 19.

Figure 7 shows how at each of the posts 7, the strain gauges 36 and 37 carried by the cantilever unit 19 and the strain gauges 38 and 39 carried by the cantilever unit 21 are connected together in a bridge circuit by connecting leads carried through the hollow interior of the post. The outgoing leads 40—44 inclusive extend to the bottom of the post 7 and emerge in the cavity 4, whence they are carried, preferably in conduit buried in the coping 2 of the wall, to a central location for connection to the alarm circuitry.

The bridge circuit as shown in Figure 8, preferably has the strain gauges on the one side of the post 7 transposed with respect to those on the other side. In the example illustrated, the gauges 36 and 38, which are connected in series on the left half of the bridge circuit are mounted respectively on the upper and lower left hand cantilever units whereas the gauges 39 and 37, similarly connected in the right half of the bridge, are mounted respectively on the lower and upper right hand cantilever units.

In the central equipment, a potentiometer

45 is connected between the leads 40 and 42, an individual potentiometer being provided corresponding to each individual strain gauge bridge in the system, for use in balancing its respective bridges during the initial setting up of the system. The leads 41 and 43 from each bridge are connected to the terminals of a power supply unit. An output for each bridge will then be obtained between the lead 44 and the slider 46 of the potentiometer 45.

The outputs of the individual bridges are connected to corresponding inputs of an alarm unit which is adapted to produce an alarm signal when the magnitude of any individual input exceeds a predetermined limit. Suitable circuit arrangements will be apparent to those skilled in the art, hence no further description is given of the alarm unit.

The wires are initially tensioned in such a manner that the pull exerted on a wire support unit by the wires in one span of the fence is balanced by the pull of the wires in the adjacent span. Hence there is no resultant force tending to deflect the cantilevers securing that support unit to its post and the strain gauge bridge associated with those cantilevers is balanced. Any force subsequently applied to one or more of the wires produces an unbalanced pull on the wire support unit, with consequent deflection of the cantilevers and unbalance of the strain gauge bridge. An alarm circuit is triggered if the said unbalance exceeds a threshold limit. The force on the wire necessary to trip the alarm may be varied by adjusting the gain of an amplifier in the trip circuit.

A force applied to a post will produce changes in the tensions of the wires attached to that post, hence causing deflection of the cantilevers, and so trip the alarm.

A large force applied to one or more of the wires, as for example by an attempt to climb the fence or to use it as an anchorage for a climbiing rope will fracture the shear pins incorporated in the wire straining devices so freeing the wire from its wire support unit. This will unbalance the strain gauges and produce an alarm. Similarly, a large force applied directly to a post will fracture the shear pins securing the post to its anchor unit, and cause the post to rotate about its pivot pin unbalancing the strain gauges on that or the adjacent posts, and cause an alarm.

According to a modification the position of the pivot pin 8 and shear pins 9 can be reversed, i.e. the pivot pin can be arranged above the shear pins.

According to a further modification the pivot pin may also be a frangible pin which will shear if a large force is applied to a post, whereby the post will be completely freed from its anchor unit.

WHAT WE CLAIM IS:—

1. A security fence comprising a plurality of spaced posts and wires extending between the posts wherein said fence incorporates strain gauges which are arranged to produce a warning signal if a stress above a predetermined threshold limit is imposed on any of the wires or posts.

2. A fence as claimed in claim 1, in which the wires are supported by members attached to cantilevers extending from the posts normal to the line of the fence and the strain gauges are attached to at least some of the cantilevers.

3. A fence as claimed in claim 2, wherein the strain gauges are attached to the cantilevers on at least each alternate post.

4. A fence as claimed in claim 2 or 3, having cantilevers arranged both adjacent the top and the bottom of a post and a wire support unit to which the wires are attached secured between the ends of the cantilevers.

5. A fence as claimed in claim 4, wherein the cantilevers project from both sides of the post normal to the line of the fence and wire support units are secured to the ends of the cantilevers on both sides of the post.

6. A fence as claimed in claim 5, wherein the wires spanning the gap between any two adjacent posts are divided into two groups, the wires of one group being attached to the support units on one side of the posts and the wires of the second group being attached to the support units on the other side of the posts.

7. A fence as claimed in claim 4, 5 or 6, wherein each wire is attached at its one end to a wire support unit carried from one post by anchor means including a frangible pin which breaks when a force above a predetermined limit is applied to it, and the wire is attached at its other end to the wire support unit of the next adjacent post by adjustable tensioning means.

8. A fence as claimed in claim 7, wherein the wires are initially tensioned in such a manner that the pull exerted on a wire support unit by the wires in one section of the fence is balanced by the pull of the wires in the next adjacent section of the fence.

9. A fence as claimed in any preceding claim, wherein the lower end of each post is attached by pivot means to an anchor unit by means of which the post is secured in its desired position, said pivot means permitting movement of the post in a plane transverse to the line of the fence and restraining means including at least one frangible member adapted to retain the post in a substantially vertical position until a force is exerted thereon which is sufficient to break the frangible member and allow the post to pivot.

10. A fence as claimed in claim 9, wherein each post is provided with stays which are attached to the post at their upper end and which extend away from the post along the line of the fence and which terminate at their lower ends in adjustment means to assist in

holding the post rigid in a direction parallel to the line of the fence whilst being free to rotate about its pivot if the frangible member breaks.

11. A fence as claimed in claim 10, wherein the adjustment means comprises a rotatable cam member and means for locking the cam member in an adjusted position.

12. A fence as claimed in claim 9, 10 or 11, including a cover member surrounding the lower end of each post for protecting the pivot mechanism from the weather and foreign bodies which might obstruct the pivotal movement of the post.

13. A fence as claimed in claim 9, wherein the pivot means is also a frangible pin which will shear if a sufficient force is applied to the post.

14. A fence as claimed in any preceding claim wherein the strain gauges associated with any one post are connected in a bridge circuit which may be balanced by adjustment of the tension in the wires connected to that post, the bridge circuits from a plurality of posts being connected to a common alarm circuit which is adapted to produce an alarm signal when the lack of balance in any one of the bridge circuits exceeds a predetermined amount.

15. A fence as claimed in any preceding claim, mounted on the top of a wall or parapet wherein the support members for the lower ends of the posts are disposed in cavities provided in the wall or parapet.

16. A security fence substantially as hereinbefore described with reference to the accompanying drawings.

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Chartered Patent Agents.

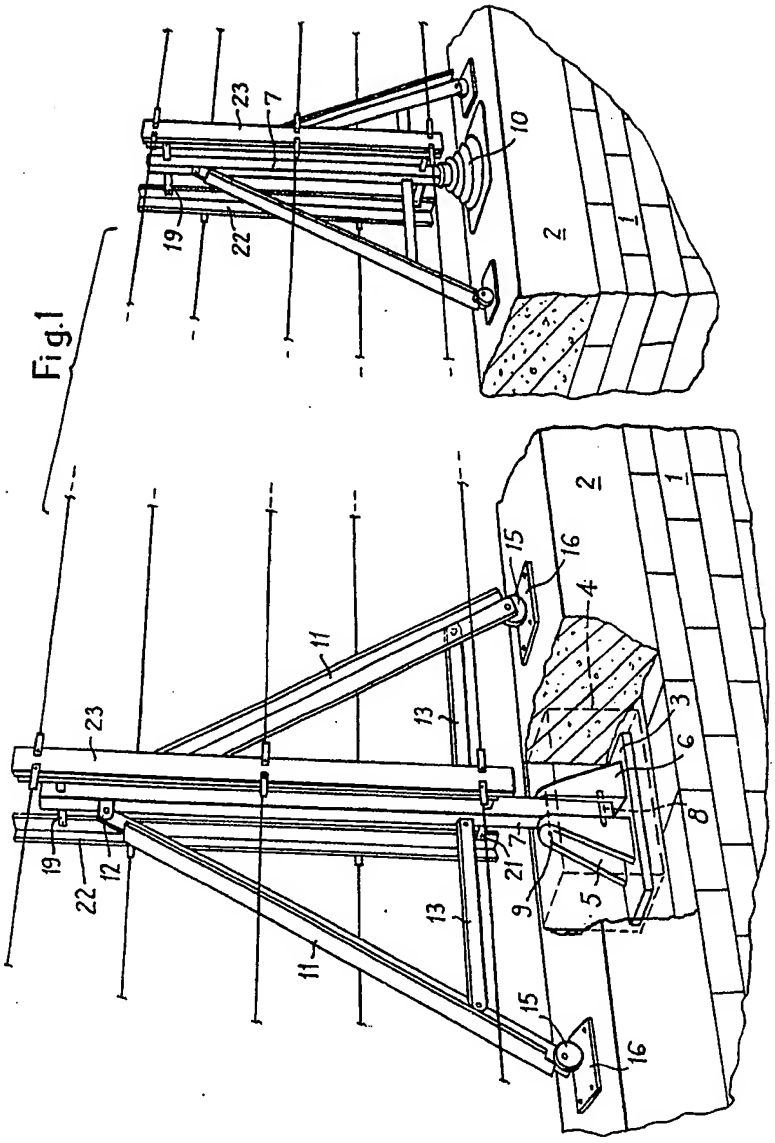
Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1974.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1354057 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1



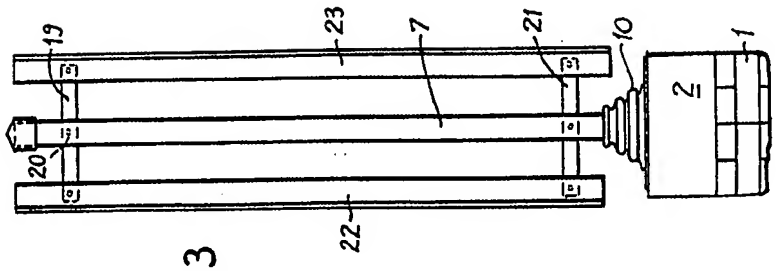


Fig.3

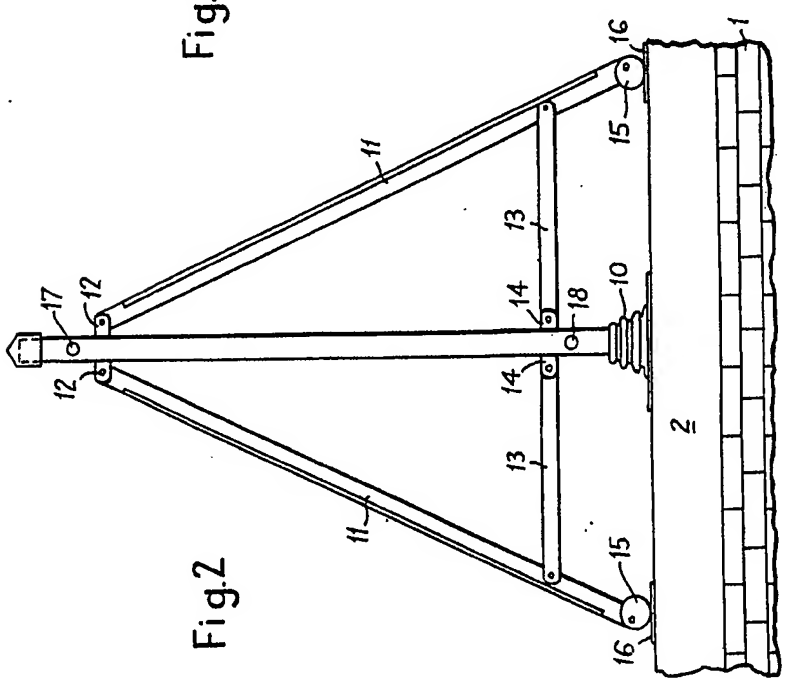


Fig.2

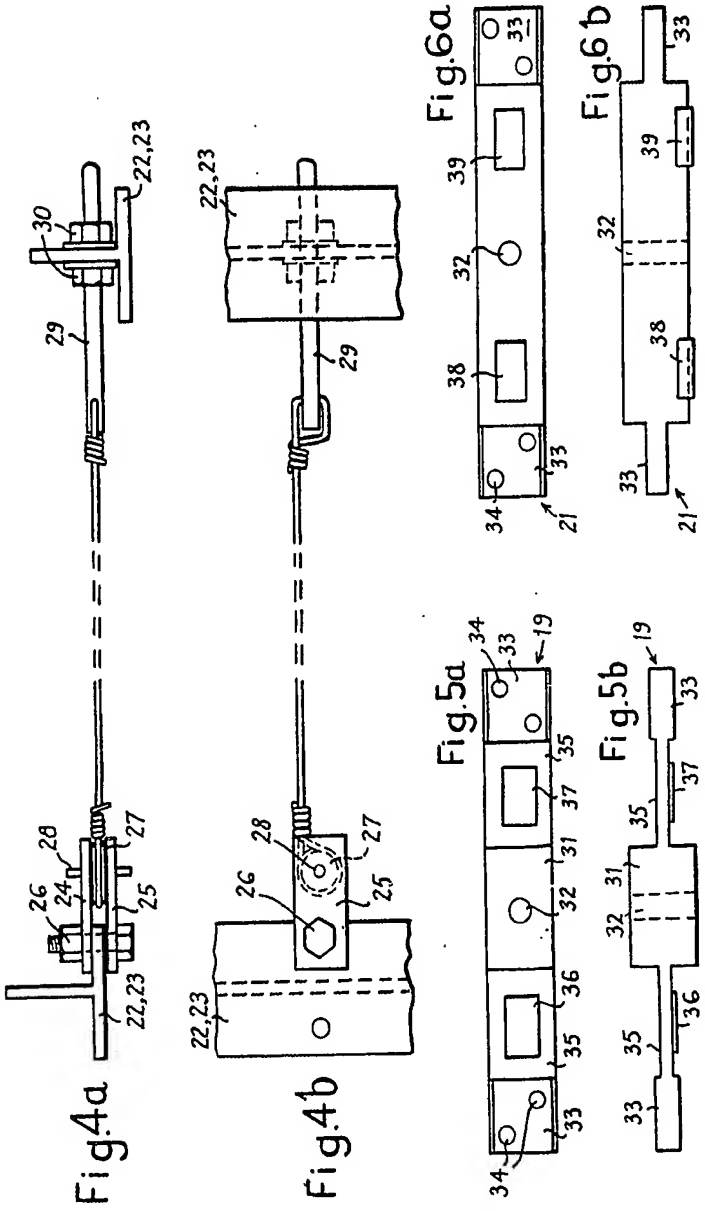


Fig.4a
Fig.4b
Fig.5a
Fig.5b
Fig.6a
Fig.6b

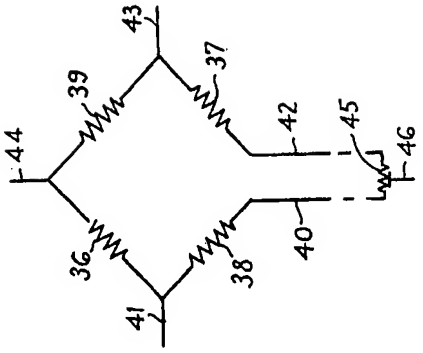


Fig.8

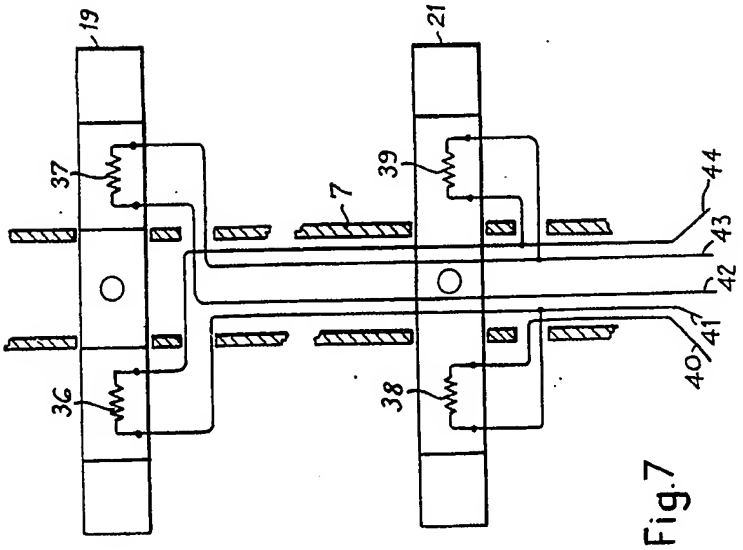


Fig.7